[COMMITTEE PRINT]

ALTERNATE PLAN FOR MOUNTAIN HOME IRRIGATION AND DRAINAGE PROJECT, IDAHO

MEMORANDUM REPORT ON AN ALTERNATE PLAN MOUNTAIN HOME IRRIGATION AND DRAINAGE PROJECT, IDAHO

Prepared at the Request of
HON. HAMER H. BUDGE, MEMBER OF CONGRESS
by
JAMES K. CARR
Engineering Consultant
Committee on Interior and Insular Affairs
House of Representatives
83d Congress, 1st Session

MAY 1, 1953

Printed for the use of the Committee on Interior and Insular Affairs
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LETTERS OF TRANSMITTAL

LETTER FROM MR. CARR TO CONGRESSMAN BUDGE, TRANSMITTING REPORT

APRIL 20, 1953.

Hon. HAMER H. BUDGE,
Member of Congress, House of Representatives,
Washington, D. C.

DEAR CONGRESSMAN BUDGE: In response to your request of March 23, 1953, I have made an engineering analysis of the alternate plan for the proposed Mountain Home irrigation and drainage project in Idaho, outlined in Mr. W. G. Sloan's report of March 17, 1953. The March 17, 1953, report is a modified version of the proposal set forth in Mr. Sloan's report of November 1952 on which I reported earlier.

An analysis of the latest proposals shows that it is economically justified. Annual benefits would amount to about 4.7 times the annual costs. The project is financially feasible, assuming water charges well within the water users' ability to repay and reasonable charges for drainage and power. If constructed under reclamation law, repayment can be made in less than 50 years after a 10-year development period.

In this report the drainage benfits have been mentioned, but no attempt has been made to fully appraise them. It should be emphasized, however, that a preliminary examination indicates that the drainage benefits would be very great and, in themselves, would probably justify further study of this proposal.

My findings, including my conclusions and recommendations, are presented in the attached report.

Sincerely yours,

JAMES K. CARR,
Civil Engineer,
Consultant on Irrigation and Reclamation,
Committee on Interior and Insular Affairs.

LETTER FROM CONGRESSMAN BUDGE TO CHAIRMAN MILLER, ENCLOSING REPORT AND LETTER TO SECRETARY OF THE INTERIOR McKAY

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D. C., April 28, 1953.

Hon. A. L. MILLER,
Chairman, Committee on Interior and Insular Affairs,
House of Representatives, Washington, D. C.

MY DEAR MR. CHAIRMAN: A copy of the engineering analysis of the alternate plan for the Mountain Home reclamation project in Idaho, prepared by James K. Carr, engineering consultant for your

committee, is enclosed. Mr. Carr's analysis is a review of the plan submitted March 17 by W. G. Sloan, a former Idaho resident, now consulting engineer in California. The plan is suggested as a substitute for the Payette diversion proposal of the United States Bureau of Reclamation. A copy of Mr. Sloan's report is also enclosed.

It is my desire that the people concerned and the Members of Congress will become completely informed about this possibility, and I believe that it merits full investigation. You will note in the attached letter of March 29, 1953, to Secretary McKay, that I requested a full-scale investigation of the alternate plan by the Bureau of Reclamation, and I am pleased to report that I received a favorable response from the Secretary. It appears that the investigations will be well under way by the middle of the summer.

This proposal has revived the hopes of the people of southern Idaho that an economical way can be found to bring about the irrigation of the fertile lands in the Mountain Home Desert. This has been a dream of Idaho residents for more than 50 years.

I believe you will agree with me that this project is of such great importance we should completely explore it and keep the interested parties completely informed about it. Looking toward achieving that purpose I am suggesting that you make this information available to the members of the committee and others in the form of a committee print. I believe it would be very helpful, especially because of the investigations that are in progress.

Thank you again for your cooperation in making Mr. Carr available to complete this engineering analysis. It should be of special value to the members of your committee if legislation is introduced to carry the project forward.

Sincerely yours,

HAMER H. BUDGE, *Member of Congress.*

MARCH 27, 1953.

Hon. DOUGLAS MCKAY,
Secretary of the Interior, Washington, D. C.

MY DEAR MR. SECRETARY: Because of your service on the Columbia Basin interagency committees, you are familiar with some of the proposals to irrigate the fertile lands of the Mountain Home Desert in southern Idaho. Past proposals have been so costly as to prevent widespread support by the potential irrigators and responsible State officials. One such proposal is the Bureau of Reclamation's Payette unit plan, which is published in House Document 473, 81st Congress, 2d session.

Hope for an economical solution to the irrigation problem has been renewed recently because of an alternate plan for the Mountain Home project outlined in the attached report dated March 17, 1953. The report, combining a plan for both irrigation and drainage, was prepared by W. G. Sloan, a consulting engineer, who has had many years of experience with Idaho reclamation problems. The March 17 report by Mr. Sloan is a modification of a plan proposed by him last November. The later report incorporates some suggestions made recently by me and others, so as to obtain additional revenues and assist the irrigators in repayment of project costs, thus making the proposal more financially feasible.

As with the November report, I have arranged through the cooperation of Chairman A. L. Miller for an analysis of the project's feasibility by James K. Carr, engineering consultant for the House Committee on Interior and Insular Affairs. The additional information to be developed by Mr. Carr will be sent to you as soon as practicable.

Preliminary review of the alternate plan, by Mr. Carr, indicates the proposal has considerable merit and that an analysis of its economic justification will show a high ratio of benefits to cost. It appears to be financially feasible depending, of course, on the rates that are to be charged in the sale of water and power.

Additional irrigation in the State of Idaho, especially in the Mountain Home area, is of such great importance to the State and the Nation that we must not leave a stone unturned in the search for an economical plan to put these land and water resources to more beneficial use. Therefore, I respectfully request that the Department of the Interior, through its several agencies, assist the people of Idaho in making an investigation of this alternate plan for the Mountain Home project.

Work could be initiated by allocating funds from the appropriations for general investigations of the Bureau of Reclamation. Perhaps other agencies and organizations can participate in a study of the alternate plan in accord with the President's desire for establishing a working partnership of Federal, State, and local representatives in planning the development of our country's natural resources. I shall be pleased at your convenience to discuss the proposed study in more detail.

In connection with the desire of the local people for a study of the alternate plan, I am pleased to enclose a copy of a letter dated March 18, 1953, from Mr. Mark R. Kulp, chairman of the Boise Valley Drainage Committee. You will note that the Boise Valley Drainage Committee and the Mountain Home Reclamation Committee held their first joint meeting on March 17. A list of those who attended the March 17 meeting is also attached.

If this investigation can be included in the Department's program, I suggest plans for commencing the study should begin as soon as possible, especially if field work is to be done during the coming summer months.

Your early reply to my request will be appreciated.

Very truly yours,

HAMER H. BUDGE,
Member of Congress.

LETTER FROM CHAIRMAN MILLER TO CONGRESSMAN BUDGE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
HOUSE OF REPRESENTATIVES,
Washington D. C., April 29, 1953.

Hon. HAMER H. BUDGE,
Member of Congress,
House of Representatives.

DEAR COLLEAGUE: Your letter of April 28, transmitting Mr. Carr's report analyzing Mr. Sloan's proposal for the Mountain Home irrigation and drainage project in Idaho, has been received together with related correspondence, and I note your request that this

material be made available to the members of our committee and others in the form of a committee print.

It is my general policy to hold the number of committee prints to a minimum and only to include data that is directly related to matters that may come before the Committee on Interior and Insular Affairs.

I find that this material contains a substitute plan for irrigating the lands proposed for future irrigation in H. R. 4648, a bill that has been referred to our committee. It appears that if the present Interior Department investigation proves this alternate project feasible, the material you have submitted will be very helpful in the consideration of the plans suggested for irrigating these lands.

In view of the above-mentioned importance of this data, I am pleased to comply with your request and have directed the committee staff to order the material printed.

Sincerely yours,

A. L. MILLER, *Chairman.*

MEMORANDUM REPORT
ON
AN ALTERNATE PLAN
MOUNTAIN HOME IRRIGATION AND DRAINAGE PROJECT, IDAHO

PREPARED AT THE REQUEST OF
HON. HAMER H. BUDGE, MEMBER OF CONGRESS
BY
JAMES K. CARR
CIVIL ENGINEER
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS
HOUSE OF REPRESENTATIVES

32851—53——2

MEMORANDUM REPORT

APRIL 20, 1953.

To: Hon. Hamer H. Budge, Member of Congress.
From: James K. Carr, Civil Engineer.
Subject: Feasibility of an alternate plan, Mountain Home irrigation and drainage project, Idaho.

INTRODUCTION

The alternate plan outlined in a preliminary report dated March 17, 1953, is a proposal by a former Idaho resident, consulting engineer, W. G. Sloan, of LaMesa, Calif. It has been offered after preliminary studies as an alternative for an earlier proposal (1949) by the United States Bureau of Reclamation to irrigate lands near Mountain Home and Boise, Idaho. The Bureau's Payette unit plan is outlined in volume II of House Document 473, 81st Congress, pages 211–306. The alternate plan advocated by Mr. Sloan is similar to a plan which was discussed in a Bureau of Reclamation report (April 1936), by J. R. Riter and John A. Kiemig, entitled "Boise River Investigations, Idaho." The alternate plan in the March 17, 1953, report is a modification of Mr. Sloan's earlier report to include changes suggested by you and others in order to provide more revenue-producing features and reduce the cost of water to the irrigator. The area to be served under the alternate plan is 123,000 acres as compared to 192,000 acres (183,000 net) under the Bureau plan.

The principal difference in the alternate plan and the Bureau's Payette unit plan, so far as irrigation is concerned, is the proposed pumping of Snake River water and the use of ground water that can be "salvaged" in the Boise Valley with resulting drainage benefits, both in lieu of diversion of water through a long tunnel from the Payette River watershed with incidental power development.

The principal difference in this analysis of the alternate plan and Mr. Sloan's analysis is in the matter of operation, maintenance, and replacement costs. Inasmuch as it has been suggested that the alternate plan might be built as a Federal reclamation project, an attempt has been made to use the latest Bureau estimates of operating costs. The Bureau costs appear to be high in some instances. If they can be reduced then water charges might be reduced accordingly. The higher costs should be assumed, in my opinion, until more definite information is available.

An analysis was made of the feasibility of the alternate plan, including some comparisons between it and the Bureau of Reclamation proposal. For more ready reference the analysis is subdivided into the following chapters:

A. Project plan
B. Lands to be served
C. Water requirements
D. Water supplies
E. Cost of project works
F. Economic justification
G. Repayment

As a result of the analysis my conclusions are hereinafter stated, and recommendations are made in accordance with your request of March 23, 1953. They are listed in the paragraphs immediately following a summary sheet. Thereafter follows an analysis of feasibility in its component parts with discussion and information on the abovementioned factors which affect project feasibility. Prior to a statement of my conclusions and recommendations it should be emphasized that Mr. Sloan's report is of a preliminary character and is so regarded in my analysis of it. My review is necessarily based on preliminary data.

SUMMARY SHEET

Location: Ada and Elmore Counties, Idaho.

Purpose: Irrigation, drainage, and incidental power development.

Area to be irrigated: 123,000 acres.

Water requirements: 600,000 acre-feet.

Water supply: From Boise River, Snake River, and underground sources.

Power generation: 316,000,000 kilowatt-hours in median year.

Pumping requirement: 91,400,000 kilowatt-hours in median year.

Power sales: 177,000,000 kilowatt-hours in median year.

Annual equivalent benefits, costs, ratio: Benefits, $10,771,000; costs, $2,269,604; ratio 4.7 to 1.

Capital cost: $54,049,000.

Investment per acre: $440.

Operation, maintenance, and replacement costs: $840,747 annually.

Repayment: Under reclamation law, 52 years after development period with plan A; 50 years with plan B; 47 years with plan C.

CONCLUSIONS

A. Project Plan

The project plan is feasible from an engineering viewpoint. It adopts parts of the Bureau of Reclamation's Payette unit plan and the Lucky Peak power plant proposed by the Corps of Engineers.

B. Lands To Be Served

The new lands to be served under the alternate plan are of class 1 and class 2 quality, and there appears to be no question about their ability to sustain irrigated agriculture. Prospective drainage benefits alone appear to justify further study of the alternate plan.

C. Water Requirements

The total water requirement of 600,000 acre-feet for 123,000 acres, computed in the Sloan report, on the basis of 4.85 acre-feet per acre, may be an optimistic estimate and could result in a reduction of project lands in the amount of 12,500 acres in the final project plan should the unit estimate of the Bureau (5.4 acre-feet per acre) prove to be more accurate.

D. Water Supply

A water supply of 600,000 acre-feet appears to be available during dry years by pumping from ground water and pumping from the Snake River. Some surplus flows are available from the Boise River and can be used to lower average costs of supplying water to the project. There is some question about the number of drainage wells and total pumping required to provide the water supply from salvaged ground water, especially during dry periods when nearly the entire water supply is derived from pumping. Exchanges of water rights to obtain the water supply and the negotiation and cooperation entailed in the exchanges will be a major problem before project construction can begin.

E. Cost of Project Works

The capital cost of project works proposed in the alternate plan would be about $54,049,000 at March 1953 prices. Operation, maintenance, and replacement costs are estimated in this report at $840,747 annually, or $6.84 per acre as compared to costs of $471,852 annually and $3.84 per acre in the Sloan report of March 17, 1953. Any increase in the number of wells or the pumping required to obtain the water supply will, of course, result in an increase in these costs. Operation, maintenance, and replacement costs are the key to financial feasibility. They should be studied very thoroughly.

F. Economic Justification

The alternate plan is economically justified, showing a ratio of annual equivalent irrigation benefits ($10,771,000) to annual costs ($2,269,604) of 4.7 to 1. This compares with a ratio of 2 to 1 for the Bureau's Payette unit plan. The two plans are not altogether comparable. It appears that the alternate plan is economically justified even if water supplies are reduced and costs are increased as indicated in C, D, and E above. This is a very favorable ratio for this type of project due, in part, to the fact that reservoir storage costs are not chargeable to the new lands.

G. Repayment

The alternate plan is financially feasible and can be repaid under the provisions of the reclamation law with water charges which are well within the repayment capacity of the water users and with reasonable charges for drainage and power.

RECOMMENDATIONS

1. The Department of the Interior should make a study and prepare a report on the alternate plan as soon as practicable, utilizing as fully as practicable the assistance that could be provided by representative local interests.

2. The investigation should include the initiation as soon as possible of a study including field tests and geological surveys to determine the probable yield from ground-water pumping, its cost, its effect on

presently used return flows and the probable drainage benefits together with a study of available supplies which can be pumped from the Snake River.

3. The investigation should include an examination of maintenance and replacement costs for the alternate plan because these costs are the key to financial feasibility of the project if it is to be constructed under reclamation law.

4. The investigation should be broad in scope; consider fully the ultimate needs of the entire area; the sources of water therefor; and utilize existing data from public and private sources so as to avoid duplication of costs.

A. PROJECT PLAN

The alternate plan, a drainage and irrigation project, proposes that certain amounts of water presently used in the Boise Valley below Boise be exchanged for supplies from substitute sources thereby permitting an annual average diversion of 540,000 acre-feet from the south fork of the Boise River to irrigate 111,000 acres of land on the Long Tom division near Mountain Home. The replacement would be accomplished by pumping an average of 150,000 acre-feet annually via Deer Flat Reservoir from Snake River near Marsing Bridge and by pumping from an estimated 450 wells to be installed adjacent to the existing main canals in the Boise Valley. The wells would provide urgently needed drainage and lower the water table 4½ or 5 feet under approximately 225,000 acres in the Boise Valley. The water pumped from Snake River would also serve by exchange to irrigate 12,000 acres in the proposed Hillcrest division.

The principal project features described in more detail in subsequent paragraphs may be summarized as follows:

(*a*) Boise Valley drainage wells
(*b*) Deer Flat pumping and generating plant
(*c*) Features of the Hillcrest division
(*d*) Features of the Long Tom division
(*e*) Canyon Creek powerplant
(*f*) Lucky Peak powerplant

(*a*) *Boise Valley drainage wells*

The report suggests installation of 450 drainage wells by drilling them at intervals of approximately one quarter of a mile, adjacent to each of the main supply canals below the Boise diversion dam. The water would be delivered into canals for reuse. The wells would have an estimated capacity each of 2 second-feet and an average depth of 60 feet.

> Should the development of ground water interfere with presently used return flows, additional wells will be supplied at the critical points to insure no impairment of existing rights—

the report states.

(*b*) *Deer Flat pumping and generating plant*

The report gives this information on the Deer Flat plant:

> The supplementary supply from the Snake River, by pumping into Deer Flat, would be accomplished by a plant located on the river near the Marsing Bridge and delivered through a penstock into Deer Flat Reservoir. There is ample flow in Snake River at this site at all times to furnish the amount required without interfering with any water rights below.

This plant would be designed as a combination pumping and generating plant whereby water would be pumped into the reservoir during off-peak generation periods and additional power generated by running water out of the reservoir back through the pump-generator plant to develop on-peak power. Preliminary studies have indicated that considerable saving can be made by this type of pumping plant over a straight pumping operation and the advantages far outweigh the increased cost of the installation. Over the past 56-year period it has been found that the plant would need to operate in 29 years out of the last 56, with partial operation for a few years and for the remaining years would not be needed at all.

The study of the use of the combination pumping-generating plant is of a preliminary nature, and time has not permitted refinement of the preliminary estimate.

(*c*) *Features of the Hillcrest division*

The map in the Sloan report shows that project works for the Hillcrest division would be a diversion dam or pumping structure on the Boise River below Lucky Peak Dam, a main canal, a lateral system, and a drainage system all estimated to cost $1,500,000 at March 1953 prices. The Bureau report (H. Doc. 473, vol. II, 81st Cong., pp. 243 and 244), from which Mr. Sloan takes his basic estimates, shows drainage costs estimated at $25 per acre of irrigable land and lateral-system costs estimated at $50 per acre. On this basis drainage and lateral systems would cost $900,000 for the Hillcrest division, leaving $600,000 for the main canal and the diversion structure. (Also see footnote 3, table III.)

(*d*) *Features of the Long Tom division*

The Sloan report states that project works and costs for the Long Tom division are the same as in the Bureau report—

except for proportionate increases in the Long Tom division, due to the slight increase in acreage.

The following description of project works for the Long Tom division is given on page 244 of House Document 473, 81st Congress (vol. II):

DIVERSION DAM ON BOISE RIVER

Water for the Long Tom division would be diverted from the south fork of the Boise River at a point about 5 miles downstream from Anderson Ranch Dam, an earthfill structure in the final stages of construction by the Bureau of Reclamation to provide storage for the Boise project and also to produce hydroelectric power. The diversion dam would consist of a hollow, reinforced concrete overflow section 300 feet long, rising 30 feet above stream bed, and 2 slab-and-buttress nonoverflow sections with total length of 125 feet, rising 45 feet above stream bed. The total estimated cost is $1,943,000.

LONG TOM TUNNEL

Diversions from the south fork would be made into the Long Tom tunnel from the pool above the diversion dam. This tunnel would have a capacity of 2,000 cubic feet per second and would be 15 feet in diameter and about 7.2 miles in length. The tunnel would discharge into Long Tom Creek just above its confluence with Canyon Creek. The creek channels would be used to deliver water to the project area. The estimated cost of the tunnel is $17,479,000.

CANYON CREEK DIVERSION DAM

Diversion from Canyon Creek to the project lands would be made at a point 6 miles below the tunnel outlet. The diversion dam would consist of a concrete, nonoverflow structure, 20 feet in height and 150 feet long, with an estimated cost of $175,000.

LONG TOM MAIN CANAL SYSTEM

Main canals for the Long Tom division would extend in both directions from the Canyon Creek diversion dam. Each of these canals would in turn split into two other major canals serving the irrigable areas. The total estimated cost of the Long Tom main canal system is $3,186,000.

LATERAL SYSTEM

The lateral system for the Long Tom division, estimated in the same manner as for the Hillcrest division, would have a cost of $5,250,000.

DRAINAGE

Drainage conditions for the entire unit were discussed under the Hillcrest division. The estimated cost of drainage for the Long Tom division is about $2,625,000.

(*e*) *Canyon Creek powerplant*

The Canyon Creek powerplant would require the following project features to utilize 185 feet of available head between the outlet of Long Tom tunnel and the Mountain Home area:

Diversion dam: Gravity section, 55 feet high, 136-foot crest length.

Diversion canal: 2 miles long.

Steel penstock: 1,600 feet long, 15 feet in diameter.

Powerplant: 23,000 kilowatts.

(*f*) *Lucky Peak powerplant*

Powerplant: 48,000 kilowatts, 220 average head. On this subject the report states:

Lucky Peak Dam, a flood-control dam, on the Boise River just below Arrowrock Dam is now under construction. Its completion is scheduled for 1954. It is being so designed and built that power-generating facilities can be added at the lower end of the outlet tunnel which was designed for just such a contingency. The Corps of Engineers, who are building the dam, estimate that a 48,000-kilowatt installation can be made about 235,000,000 kilowatt-hours at an average head of 220 feet.

B. LANDS TO BE SERVED

The lands considered for irrigation in the Sloan plan are as follows:

	Acres
Long Tom division (immediate vicinity of Mountain Home)	111,000
Hillcrest division	12,000
Total	123,000

The lands to be irrigated under the alternate plan in the Long Tom division in the vicinity of Mountain Home, Idaho, would be lands located in a much more compact area than proposed by the Bureau.

The map in Mr. Sloan's report excludes much of the northwestern part of the Bureau's suggested Long Tom division and includes more land east and north of the air base. These latter lands are less desirable for irrigation, according to land classification studies, than those included by the Bureau. In developing a final plan considerable care should be exercised to select the better lands for inclusion in the project.

The lands to be irrigated in the proposed Hillcrest division are located on the bench lands a few miles south of Boise, Idaho. The remaining part (60,000 acres) of the Hillcrest division as originally proposed in the Bureau plan would not be irrigated, according to the alternate plan.

The bulk of the lands to be served by the alternate plan are classes 1 and 2, and there appears to be no question about their ability to sustain irrigated agriculture. The lands included in the Sloan plan are for the most part included in the lands proposed to be served by the Bureau plan. A detailed lands classification has been made, the results of which are set forth in the Bureau's report of May 18, 1949, entitled "Payette Division" (H. Doc. 437, 81st Cong.).

No attempt is made here to analyze the engineering feasibility of the drainage improvements which are proposed as a part of the Sloan plan, nor to estimate the area that might be affected by the drainage-well installations. The alternate plan contemplates the installation of 450 drainage wells with an average depth of 60 feet and an estimated capacity of 2 second-feet per well. It is anticipated these wells would lower the water table between 4½ and 5 feet over 225,000 acres of land. The report of March 17, 1953, states that by drilling the wells at intervals of about one-quarter of a mile adjacent to each of the main supply canals below the Boise diversion dam all of the water pumped from the wells can be delivered into the existing canals for reuse. It is proposed to substitute this developed water for that now used, thus making an equivalent amount available higher up on the Boise River to irrigate new lands. The alternate plan also contemplates that should these wells interfere with presently used return flows in certain areas then additional wells will be so placed as to supply these needs and insure no encroachment on existing water rights.

C. WATER REQUIREMENTS

Water, not land, is the limiting factor in the possible development of the Mountain Home irrigation project. Therefore, it is necessary to consider in detail the water supplies that are available. First, however, an examination must be made of the unit water requirements on which the total water requirements are based.

Annual water requirements for the alternate plan are estimated on the basis of a unit net diversion requirement of 4.85 acre-feet per acre. The amounts involved would be as follows:

	Acre-feet
Long Tom division	538,350
Hillcrest division	58,200
Total	596,550

Annual water requirements are, therefore, about 600,000 acre-feet divided for preliminary study purposes as follows:

	Acre-feet
Long Tom division	540,000
Hillcrest division	60,000

The total water requirement (600,000 acre-feet) for the 123,000 acres in the Sloan plan would be in addition to the 1,500,000 acre-feet now required by the 310,000 acres presently being irrigated in the Boise Valley. Construction of the Sloan alternate project would ultimately raise total water requirements to 2,100,000 acre-feet annually for the irrigation of a new total of 433,000 acres in the Boise Valley and Mountain Home areas.

The irrigation water requirement is the sum of the crop use and water losses. Estimates with respect to several factors are involved,

including consumptive use of water by crops, evaporation from the cropland, farm waste and percolation losses, and operations waste and distribution system losses.

The net diversion requirement of 4.85 acre-feet per acre for the Sloan plan is compared with 5.4 acre-feet per acre in the Bureau plan. The figure of 5.4 acre-feet per acre annually was determined from the following estimate shown on page 239 of House Document 437, 81st Congress.

TABLE I.—*Average monthly and annual water requirements, Payette unit, Mountain Home project, Idaho*

Month	Farm water requirement					
	Percent	Acre feet per acre	Conveyance system losses	Gross diversion requirement	Usable return flow	Net diversion requirement
			Percent	*Acre-feet per acre*	*Acre-feet per acre*	*Acre-feet per acre*
April	7	0.28	50	0.56	0.02	0.54
May	17	.68	34	1.03	.06	.97
June	20	.80	28	1.11	.11	1.00
July	22	.88	27	1.20	.10	1.10
August	20	.80	28	1.11	.11	1.00
September	10	.40	40	.67	.12	.55
October	4	.16	50	.32	.08	.24
Total or average	100	4.00	33⅓	6.00	.60	5.40

The 4.85 acre-feet per acre annually in the Sloan report was computed as follows:

	Acre-feet per acre
Comsumptive use	2.20
Canal and lateral losses and waste	1.90
Deep percolation from the land	.75
Total	4.85

The Sloan report on the first page refers to the rate of 2.20 acre-feet per acre as an estimate of consumptive use by the Bureau of Reclamation. The two estimates apparently agree on this factor. The other factors in Mr. Sloan's computation are explained in his report as follows:

> This figure of 4.85 acre-feet per acre is identical with the average diversions of Boise River natural stream flow over the last 10 years.
>
> The figure of 1.90 acre-feet per acre for main canal and lateral losses and surface waste is 40 percent of the diversion requirement. Reports of water used on the Boise reclamation project show an average amount of about 25 percent for canal and lateral losses. Surface waste has not been determined, but the balance of 15 percent for surface waste is a larger amount than is usually considered allowable with efficient distribution of the supply.
>
> The figure of 0.75 acre-foot for deep percolation losses is based upon experiments conducted by the Department of Agriculture on Idaho irrigated lands in 1913 and 1914, and is a much larger amount than has frequently been used by the Bureau of Reclamation in estimating the water requirements on many other projects.

The assumption that the average annual requirement in the Boise Valley (4.85 acre-feet) is applicable to the Mountain Home area is not necessarily valid because the two areas are not altogether comparable. In the Boise Valley there is a much better opportunity to redivert and

use return flows. Also it is unlikely that the better grade lands which are omitted from the Long Tom division in the Sloan plan would eventually be omitted from the final service area in favor of the poorer quality lands included in the Sloan report. Therefore, the assumption of shorter canals may not materialize to the extent suggested by Mr. Sloan. If they are not so shortened then the lower canal losses might not be realized. The unit water requirement of 4.85 would have to be increased if the area is changed and the canals are lengthened as indicated above.

A Bureau engineer has informed me that the 5.0 acre-feet per acre requirement in an earlier proposal of the Bureau was questioned by competent sources outside the Bureau. In view of the foregoing considerations, I am inclined to believe the unit requirement of 4.85 acre-feet per acre is an optimistic estimate.

A difference in total water requirement of 67,650 acre-feet is involved on the basis of the difference in the unit requirement of 0.55 acre-foot per acre between the Sloan plan and the Bureau plan. This could mean (based on the same water supply) a reduction in final project acreage of about 12,500 acres should the Bureau estimate of unit diversion requirement of 5.4 acre-feet per acre later prove to be more accurate.

D. WATER SUPPLY

The total water supply of 600,000 acre-feet for the alternate plan would be developed as follows, according to the Sloan report and the data on reservoir operation studies which has been furnished to me:

Total supply in average years:	*Acre-feet*
Source (*a*): From presently surplus flows in Boise River	225, 000
Source (*b*): Boise River water replaced by pumping salvaged ground water	225, 000
Source (*c*): Boise River water replaced by pumping Snake River water via Deer Flat Reservoir	150, 000
Total	600, 000

SUPPLY (BY DIVISIONS)

The average annual water supply by divisions would be as follows:	*Acre-feet*
Long Tom division	540, 000
Hillcrest division	60, 000

For the Long Tom division; The average annual water supply for the Long Tom division (diversion of 540,000 acre-feet through Long Tom tunnel) would be furnished by exchange under the alternate plan from the following sources:

	Acre-feet
Presently unused Boise River flows	225, 000
Boise River water replaced from Snake River via Deer Flat Reservoir	90, 000
Boise River water replaced by salvaged ground water	225, 000
Total Long Tom division	540, 000

For the Hillcrest division: The average annual water supply for the Hillcrest division under the alternate plan would be provided from Boise River water replaced with Snake River water via pumping into Deer Flat Reservoir. The amounts involved would be as follows:

	Acre-feet
Total pumped from Snake River	150, 000
Replacement of Boise River water used for Long Tom division	90, 000
Total available for replacement of Boise River water used for Hillcrest division	60, 000

The following paragraphs are a discussion of the three sources of water (in average years) which comprise the total water supply for the Sloan plan.

Source (a)—From presently surplus flows in the Boise River

The Bureau of Reclamation report (p. 237, H. Doc. 473, 81st Cong., vol. II) states that, measured just upstream from the city of Boise—

> there is an average of 330,000 acre-feet surplus flows annually in the Boise River Basin.

Mr. Sloan states in his report (p. 5):

> For a median year preliminary water-supply studies show that 225,000 acre-feet of this surplus can be regulated and used when the Lucky Peak Reservoir, to be completed in 1954, is added to and used with existing storage facilities on the river. Details of this study can be made available. In extreme dry years none of this surplus may be usable.

It should be noted that in the Bureau's plan of operation only 130,000 acre-feet of the 330,000 acre-feet of surplus flows is to be utilized as contrasted to a use of 225,000 acre-feet in the alternate plan. The Bureau report states:

> an average of 130,000 acre-feet annually—

would be made possible from—

> flows released by flood-control operations of, or spilled from, the Boise River reservoirs.

An important factor in making use of the 130,000 acre-feet according to the Bureau is that surplus flows could be effectively complemented by diversion of Payette River water. Storage in Lucky Peak Reservoir, which is now under construction for flood control, was not considered in the Bureau study, apparently. It appears that 225,000 acre-feet of surplus flows can be made usable on the average without development of holdover storage reservoirs if critical year requirements are met by extensive pumping of Boise Valley ground water and pumping of Snake River water. The irrigation capacity of the reservoir system, including Lucky Peak, is equal to 1,125,000 acre-feet. The capacity of Anderson Ranch Reservoir for irrigation is assumed at 400,000 acre-feet. Reservoir-operation studies furnished to me show that 540,000 acre-feet annually on an average can be diverted into Long Tom tunnel to meet irrigation requirements except in periods such as existed in August and September 1931. The Sloan report calls attention to this statement on page 239 of the Bureau report (H. Doc. 437, 81st Cong.):

> Regulation of the South Fork of the Boise River by Anderson Ranch Reservoir would permit an average diversion of 540,000 acre-feet annually to the Long Tom division through the Long Tom tunnel.

Reservoir-operation studies show there would be a deficiency of 51,000 acre-feet in August of a year like 1930–31 with a deficiency the next month of 53,000 acre-feet for September of the same year. For August that would mean a deficiency equal to 46 percent of the irrigation draft (estimated at 111,000 acre-feet), and for September it would mean a deficiency equal to 85 percent in the irrigation draft (estimated at 62,000 acre-feet). It is probable with careful use of the water, starting early in the irrigation season, that these shortages could be spread out over the 7-month irrigation period and thereby

prevent a complete loss of crops. A Bureau report seems to expect the same type of shortage on the average of once in 25 years which would not affect seriously the repayment of project costs which is the best measure of permissible irrigation shortages.

The adequacy of a water supply for an irrigation project must be measured in terms of conditions during the critical dry period. The adequacy of water supply in the critical period for the alternate plan is not dependent on surplus Boise River flows, and a lengthy discussion of the amount of usable surplus flows, except as it affects pumping, is relatively unimportant in this case because there were practically no surplus flows available in the entire period 1928–35. Moreover, surplus flows were not relied upon as a source of firm supply in the reservoir operation studies furnished to me in support of the Sloan report. It is concluded that surplus flows (source (a)) cannot be considered as a source contributing to a firm water supply for this project.

Operation studies show that 300,000 acre-feet of pumping from both "pump sources" would be required every year during dry periods. For instance, there would be 300,000 acre-feet of pumping each year for the period 1928–35. For purposes of analysis, therefore, a firm water supply should be examined on the basis of sources as listed in the following tabulation:

Total supply in dry years:	*Acre-feet*
Source (*a*) From presently surplus flows in Boise River	0
Source (*b*) Boise River water replaced by pumping salvaged ground water	300,000
Source (*c*) Boise River water replaced by pumping Snake River water via Deer Flat Reservoir	300,000

The adequacy of the water supply for the alternate plan, therefore, can only be determined by answering these questions on availability of ground water and availability of Snake River water discussed below as sources (*b*) and (*c*):

(1) Can an amount as high as 300,000 acre-feet of groundwater be pumped within the Boise project each year and be exchanged for Boise River natural flow or storage releases? Source (*b*).

(2) Can an amount as high as 300,000 acre-feet of water be pumped from the Snake River near Marsing Bridge each year and be effectively exchanged for Boise River natural flow or storage releases and if so, what would be the cost of pumping? Source (*c*).

Source (b)—Boise River water replaced by pumping salvaged ground water

This is the source over which there will be the most debate because the supply is underground; it is not easily measured; and it is a source which has been, in some respects, overlooked in western reclamation development. The report states:

> Sufficient information has been obtained to assure the successful drainage of the land and the development of the proposed quantity of water.

Mr. Sloan also declares:

> The proposal to drain the valley lands by wells has been made before, and to date, more than 100 wells have been constructed and are in operation—some of them for more than 25 years.

In support of the availability of an adequate quantity of water Mr. Sloan states in the report that 1,800,000 acre-feet of water is being diverted annually from the river for valley lands. Annual consumptive use in the valley is estimated at the rate of 2.20 acre-feet per acre or a total of 693,000 acre-feet per acre. The balance is 1,107,000 acre feet—

which is either wasted back to the river or goes to fill up the underground water reservoir beneath the valley lands.

"Salvaged ground water" as distinguished from total ground-water supplies is that amount which can be pumped and used without interfering with the presently used return flows. The problem appears to be recognized by Mr. Sloan because in the report he says:

Should the development of ground water interfere with presently used return flows, additional wells will be supplied at the critical points to insure no impairment of existing rights.

One report which gives an estimate of ground water that can be "salvaged" was prepared by George N. Carter and is dated January 1936. It was a memorandum in the appendix to a Bureau of Reclamation report entitled, "Boise River Investigations, Idaho," by J. R. Riter and John A. Kiemig, dated April 1936. The Carter memorandum concludes that in the Nampa-Meridian section of the Boise Valley—

40,000 acre-feet can be pumped during the latter part of the irrigation season without affecting the regimen of the river during the irrigation season.

As for the Pioneer district and the tributary area, the Carter memorandum says:

* * * there is no prospective field in this area for increasing the Boise project supply.

In Mr. Carter's analysis he says that other valley areas, notably the gravelly lands along the river bottom, are favorable for pumping with a consequent drainage benefit.

To develop this source of water the Sloan report proposes—

the construction of 450 drainage wells with an average depth of 60 feet and an estimated capacity of 2 second-feet per well.

The reservoir-operation studies for the alternate plan show that 1,040 second-feet of drainage pumping capacity would be operated during the summer as required for irrigation by the following schedule:

TABLE II.—*Drainage pumping schedule*

	April	May	June	July	August	September	October	Total
Percent of total	7.5	17	20	21.5	20.5	11.5	2	100
Acre-feet	22,500	51,000	60,000	64,500	61,500	34,500	6,000	300,000
Second-feet	375	825	1,000	1,040	994	575	100	.....

The peak drainage pumping demand with 450 wells (the number included in the cost estimate) would require an average of about 2.3 second-feet in order to produce the 1,040 second-foot capacity.

This yield per well is the average yield (2.31 second-feet) of 13 wells near Notus, as reported by J. C. Marr, a drainage engineer for the United States Department of Agriculture. The test was made in the short water year of 1931, and the wells were located in drainage district No. 4, Canyon County, at that time reported to be the largest well pumping project in the Boise Valley. Presumably the exact number and capacity of the wells to do the job will require further study. Such a program would provide a means to check more thoroughly the estimated annual cost of ground-water pumping, which in the Sloan report is based on 450 wells.

It appears probably that pumping in the amount of 300,000 acre-feet annually each year could be accomplished on the basis of runoff records and computations of return flows. However, additional wells may have to be installed and additional pumping might be required to offset the effect on presently reusable return flows. An appreciable increase in the number of wells and in pumping would have a marked effect on feasibility of the Sloan plan. There is also the question of the number of wells neede for water supply as compared to the number needed for drainage only.

From the information available it appears there is no question concerning the quality of water for irrigation purposes that would be developed from ground-water sources. In a more detailed study this question should be investigated further.

Source (c)—Boise River water replaced by pumping Snake River water via Deer Flat Reservoir

The third source of water for the alternate plan would be obtained by using Boise River water upstream and replacing it downstream with Snake River water pumped via Deer Flat Reservoir. The supplementary supply from the Snake River via Deer Flat Reservoir would be accomplished by a combination pumping and generating plant to be located on Snake River near the Marsing Bridge. Amounts pumped would vary from zero in some years to a maximum of 300,000 acre-feet in dry years.

In median water years 150,000 acre-feet can be pumped through the assumed 450 second-foot capacity plant in about 5½ months or 4,000 hours. In dry years the 300,000 acre-feet of pumping would require about 11 months or 8,000 hours.

No interference with existing water rights is anticipated in pumping 300,000 acre-feet from the Snake River at Marsing Bridge even in dry years, such as 1931, if the pumping rate does not exceed 1,000 cubic feet per second.

E. COST OF PROJECT WORKS

Capital costs

The estimated capital cost of the works in the alternate plan, based on the cost index for March 1953, is computed by Mr. Sloan as set forth in table III.

TABLE III.—*Capital costs*

Feature	Estimated cost, March 1953	Feature	Estimated cost, March 1953
Boise Valley drainage (450 wells)	[1] $3,015,000	Canyon Creek power plant: [5]	
Deer Flat pumping and generating system	[2] 3,000,000	Diversion dam	$416,000
Hillcrest division (12,000 acres) [3]	1,500,000	Diversion canal	949,000
Long Tom division (111,000 acres): [4]		Steel penstock	520,000
Diversion dam on Boise River	2,234,000	Power plant	2,070,000
Long Tom tunnel	20,101,000	Lucky Peak powerplant [6]	6,000,000
Canyon Creek diversion dam	201,000	Total	54,049,000
Long Tom Main canal	4,124,000		
Lateral system	6,613,000		
Drainage system	3,306,000		

[1] Based on $6,700 per well. Amounts to about $10 per acre of presently irrigated land.
[2] See method for computing cost—p. 7 Sloan report of Mar. 17, 1953.
[3] If on same basis of estimates for Long Tom division, laterals would cost $720,000, drainage $360,000, leaving $420,000 for main canal and diversion structure.
[4] Costs are those estimated by Bureau, H. Doc. 473, 81st Cong., with an increase of 15 percent to allow for increases in construction cost from April 1949 to March 1953.
[5] See p. 10, Sloan report. $90 per kilowatt is based on construction of open-air-deck-type plant under ideal construction conditions with no coffer dam or other "water" problems.
[6] Additional information shows construction price of $125 per kilowatt, based on open-air-deck-type plant, and per kilowatt costs (installed), estimated on basis of this breakdown: Generators, $32; turbines, $26; power plant up to deck, $24; switchyard and equipment, $33; penstock connections and coffer dams, $10.

The costs for power plants and pumping plants appear to be low in comparison with Reclamation Bureau costs for similar construction. However, the estimates in the report are apparently based on "open-air-deck type" construction of these plants. It may be desirable to have the Bureau prepare estimates for this type of structure if the costs are to be held to a minimum and this type of design is found to be adequate.

Operation, maintenance, and replacement costs

TABLE IV.—*Operation, maintenance, and replacement costs*

Item	Operation and maintenance	Replacement	Total
Boise Valley drainage (450 wells)	[1] $12,000	[2] $32,600	$44,600
Deer Flat pumping and generating system (15,000 kilowatts)	[3] 49,000	[2] 32,400	81,400
Hillcrest division:			
Diversion structure and main canal	11,800	2,070	13,870
Distribution and drainage	28,400	2,300	30,700
Hillcrest pumping plant	[1] 12,000	[1] 15,000	27,000
Hillcrest subtotal	52,200	19,370	71,570
Long Tom division:			
Diversion dam on Boise River	4,750	575	5,325
Long Tom tunnel	3,500	1,600	5,100
Long Tom Canal	83,000	6,800	89,800
Distribution and drainage	207,000	16,800	223,800
Long Tom subtotal	298,250	25,775	324,025
Canyon Creek powerplant	[3] 63,000	[2] 28,000	91,000
Lucky Peak powerplant	[3] 98,000	[2] 64,800	162,800
Interest and amortization on allocation to commercial power	65,352		65,352
Total	[4] 637,802	202,945	[4] 840,747

[1] Assumed that this is a recent estimate. Time did not permit a review of the elements of costs involved, but appears to be low.
[2] Based on 100 percent replacement in 45 years, 3 percent sinking fund.
[3] Based on latest tables compiled by the Bureau of Reclamation from operating experience.
[4] Does not include energy charges; see explanation of payment in energy for wheeling and direct consumption of project power for pumping.

It is noted that the latest Sloan estimate on operation, maintenance, and replacement costs includes items taken from table 15, page 248, House Document 473, 81st Congress (vol. II). Those costs were based on Bureau of Reclamation procedure which has since been modified by an "advance supplement" to the Reclamation Manual dated September 28, 1951. It revised the procedure in order to make a more up-to-date long-term projection of operation and maintenance costs. The procedure had been approved in the August 28, 1951, report of the Federal Interagency River Basin Committee. It establishes new standards for costs which are tied to the estimated long-term cost index (180) of the Engineering News Record (1939=100).

As a result of the revision, all four operation and maintenance estimates from table 15 of the Bureau report are increased by 58 percent to bring them to an index of 180 (1939=100). Replacement costs are increased 15 percent on the same basis as increases made by Mr. Sloan for capital costs. Corrections are hereinafter made in the estimate of project benefits to make the costs and benefits comparable. Mr. Sloan's estimates of operation, maintenance, and replacement have been accepted as adequate except as indicated by footnote in the table. The latest estimates for operation, maintenance, and replacement costs are shown in the foregoing table IV.

Transmission and power distribution costs

As shown on pages 11 and 12 of Mr. Sloan's report, the alternate plan proposes that the Idaho Power Co. "wheel" power to the various points of use. The company would receive payment in terms of energy and therefore transmission and power distribution costs are already included in other project costs. Transmission facilities are presently available, except for minor changes. It is verbally reported that the cost of "wheeling" is based on figures which are consistent with charges set forth in a contract now in effect between the Idaho Power Co. and the Bureau of Reclamation.

The Lucky Peak power would be generated within 10 miles of one of the company's major load centers. The power would be generated at a time when the company is confronted with meeting the irrigation pumping load. In this report no examination has been made of the proposed power distribution charges in terms of energy, to see if they are fair and equitable. A detailed analysis of these costs and transmission charges should be made in any final study of the alternate plan. The cost of producing the 316,00,000 kilowatt-hours of energy in a median year is estimated to be $543,842 annually or 1.07 mills per kilowatt-hour.

F. ECONOMIC JUSTIFICATION

Cost allocation

Of the $54,049,000 total cost for the alternate plan, $52,369,000 or 96.6 percent is allocated to irrigation. The allocation to irrigation includes the cost of drainage facilities in the Boise Valley. $1,680,000 or 3.4 percent is allocated to commercial power. This latter amount represents 28 percent of the cost of Lucky Peak power facilities.

In explanation of the allocation to commercial power, the report of March 17, 1953, points out that all of the output of Canyon Creek

power plant is needed for irrigation. It also shows that in a dry year 72 percent of the capacity of Lucky Peak powerplant is needed for irrigation, thus 72 percent of the cost is allocated to irrigation.

Annual costs

To determine economic justification it is necessary to compare project costs on an annual basis with project benefits on the same basis. Although it is recognized that such a comparison is not "foolproof," nevertheless it is a yardstick by which the economic justification of projects can be measured. The benefit must be greater than the cost. Financial feasibility involves ability to repay. It is a separate subject from economic justification.

A comparison to determine economic justification is not made in the preliminary report of March 17, 1953. To comply fully with your request of March 23, 1953, I have determined economic justification by establishing the ratio of benefits to cost.

The Bureau of Reclamation in determining annual costs uses a period of the useful life of the major features, or 100 years, whichever is the lesser, with interest computed at the rate of 2½ percent. Such a procedure has been followed in this analysis. Also in this estimate no storage costs are included because the reservoirs are already constructed and the costs thereof are considered "sunk costs."

The annual costs are summarized in the following table:

TABLE V.—*Annual costs*

Feature	Capital cost, by feature [1]	Amortization of capital costs (100 years, 2½ percent) [2]	Operation, maintenance, and replacement costs [3]	Total annual cost, by feature
Boise Valley drainage	$3,015,000	$82,340	$44,600	$126,940
Deer Flat pumping and generating system	3,000,000	81,930	81,400	163,330
Hillcrest division	1,500,000	40,965	71,570	112,535
Long Tom division	36,579,000	998,972	324,025	1,322,997
Canyon Creek Powerplant	3,955,000	107,711	91,000	198,711
Lucky Peak Powerplant	[4] 4,320,000	116,979	[5] 228,152	345,131
Total		1,428,897	840,747	2,269,644

[1] Based on March 1953 Cost Index (refer table III).
[2] Computed with capital recovery factor of 0.02731.
[3] Based on present standards of estimating operation, maintenance, and replacement costs (U. S. Bureau of Reclamation). See Advance Supplemental Reclamation Manual, dated Sept. 28, 1951.
Does not include $1,680,000 allocated to commercial power.
[5] Includes annual cost of $65,352 for interest and amortization for amount allocated to commercial power.

Annual benefits

Irrigation benefits for the acreage to be irrigated under the alternate plan have been computed in direct proportion to the estimates made for the larger acreage in the Bureau plan (H. Doc. 437, 81st Cong.). The irrigation benefits, computed in the Bureau report on the 1939–44 price index, have been adjusted to the 215 long-term index (1946–50=100). Annual irrigation benefits were estimated by the Bureau of Reclamation following an extensive study of the agricultural economy of the area. The results of that study are published in House Document 437, 81st Congress, pages 251–275. The chapter Agricultural Economy contains sections on The Market Outlook, Anticipated Farm Commodity Prices, Domestic Water Problems, Present and Anticipated Land Use, and Representative Farm Units. No additional study was made for this report.

Direct irrigation benefits

For the 192,000 acres the annual increase in net farm income is estimated at $6,176,000 per year in the Bureau report. The amount estimated for hired farm labor and the interest to be paid on farm capital are not included in the $6,176,000. I am informed that the Bureau in its latest procedure does not now include these items in a determination of direct benefits. (They were included in H. Doc. 437, 81st Cong.) Therefore, the direct irrigation benefits for the 192,000 acres (Bureau plan) are estimated at $6,175,000 annually. The proportionate estimate of direct irrigation benefits for the lands to be irrigated under the alternate plan is $3,956,400 annually, based on conditions for the 1939–44 period. When the adjustment is made to the 215 price level in accordance with the procedure agreed upon by the Benefits-Cost Subcommittee of the Federal Interagency River Basin Committee, the direct irrigation benefits for the alternate plan are $5,934,000.

The indirect irrigation benefits arising from the processing, handling, and distribution of farm products are estimated for the 192,000 acres of land at $5,914,000 per year in the Bureau report. The proportionate estimate of indirect benefits for the 123,000 acres of land is $3,788,600 per year on the 1939–44 price level. Estimates of indirect benefits arising from increased purchases are not included. When adjusted to the 215 price level, in accordance with the recommendations of the subcommittee on benefits and costs, the annual indirect irrigation benefits are estimated at $5,682,900 for the alternate plan.

Total irrigation benefits

Therefore, the total annual irrigation benefits for the 123,000 acres under the alternate plan are estimated at $11,617,500 in accordance with the latest practices of the Federal agencies and in reliance on a proportion between the Bureau plan and the alternate plan.

Inasmuch as there would be a delay in reaching these annual benefits because of a 10-year development period the annual benefits have been reduced about 10 percent in order to obtain the annual equivalent irrigation benefit as of the completion of construction. With this adjustment the annual equivalent irrigation benefit is corrected to $10,063,000 on the basis of a 10-year development period, straight-line increase in benefits, 100 years, and 2½-percent interest.

Total annual equivalent irrigation benefits on the basis of the foregoing amount are equal to about $82 per acre.

No estimate has been made of drainage benefits. Drainage costs, however, have been included. If drainage benefits are computed they would increase somewhat the ratio of benefits to costs hereinafter described.

Power benefits are computed on the basis of the value of the energy as measured by procurement from the cheapest alternative source. For purposes of this report it has been assumed that 4 mills per kilowatt-hour would represent that cost. Based on a median year, annual power benefits would equal 177,000,000 kilowatt-hours multiplied by 4 mills, or $708,000 each year. For purposes of this report, annual equivalent power benefits are considered equal to those for a median year or $708,000. No estimate of power benefits from the Deer Flat combination pumping and generating unit has been made. Some additional benefits could result from using the

generating facilities in certain years. The benefit-cost ratio would not be materially affected, so for purposes of this analysis the computation has been omitted.

Total annual equivalent benefits

Total annual equivalent benefits for the alternate plan are equal, therefore, to $10,063,000 plus $708,000, or a total of $10,771,000.

Benefit-cost ratio

The ratio of annual equivalent benefits ($10,771,000) to annual costs ($2,269,644) is about 4.7 to 1. The high ratio of benefits to cost is due in part to the fact that no storage costs are charged against the land to be served. Also, the power costs do not include any cost of installations at Lucky Peak to provide for future power generation, or any of the joint costs of Lucky Peak Dam and Reservoir. On the other hand, as pointed out heretofore, no drainage benefits are included, which tends to compensate for the costs that have been omitted.

G. REPAYMENT

Repayment ability

The repayment of the costs of reclamation projects allocable to irrigation is based on the "ability of the water users to pay." It is usually determined by a study of representative farm budgets and an analysis of economic conditions for the particular project and area. The authority for repayment contracts, based on the ability to pay, is in the Reclamation Project Act of 1939.

The Bureau report (H. Doc. 437, 81st Cong., p. 274) discusses the probable earning capacities of 80-acre farms on different types of soil in the Mountain Home area and reaches certain conclusions concerning repayment ability, the value of water, and the desirable water charge. The Bureau found that the maximum amounts remaining, available for annual payment of water charges, varies from $1,436 per farm on the more productive lands to $201 on the poorer quality lands. The Bureau's findings which resulted in a "recommended water charge" of $5.25 per acre are summarized in the following table:

TABLE VI.—*Repayment ability and value of water by land-type association* [1]

Land-type association area	Repayment ability	
	Per farm	Per acre
Melba-like	$1,436	$19.10
Paul-like	1,049	13.95
Gooding-like	660	8.78
West Kuna-like	202	2.63
Melmont-like	201	2.67

[1] Based on farm budgets prepared for potential 80-acre farms each of 5 land-type-association areas.

Water charge

The weighted average repayment ability per acre is estimated in the Bureau report at $11.11. *The average recommended water charge is $5.25 in the Bureau report.* With a proposed variable repayment in accordance with repayment ability the charge for the poorer land

would be about $3 per acre, and the charge for the better lands would be approximately $7 per acre according to the Bureau plan.

When the adjustment in benefits is made to the 215 price level, it can be assumed that repayment ability will increase more than 50 percent. In my report it has been assumed that the weighted average repayment ability per acre is increased from $11.11 to $16.66.

Three assumptions have been made for purposes of repayment analysis on the average annual water charge per acre and the average annual drainage charge per acre. The power rate was assumed to be 4 mills per kilowatt-hour. The results of the varying rates can be seen in the following table:

TABLE VII.—*Possible repayment plans*

Item	A	B	C
Water	$7 per acre	$7.75 per acre	$8.50 per acre
Drainage	$0.75 per acre	$0.50 per acre	$0.50 per acre
Annual income from—			
New lands	$861,000	$973,250	$1,045,500
Drained lands	225,000	150,000	150,000
Power sales	708,000	708,000	708,000
Total annual income	1,794,000	1,831,250	1,903,500
Annual expenses after development period	840,747	840,747	840,747
Net annual income to apply on repayment of construction costs after development period	953,253	990,503	1,062,753
Construction charges	54,049,000	54,049,000	54,049,000
Net revenue from drainage and power during 10-year development period	[1] 4,878,480	[1] 4,128,480	[1] 4,128,486
Remaining construction charges after development period	49,170,520	49,920,520	49,920,520
Period of repayment after 10-year development period years	52	50	47

[1] Net revenues would probably exceed these amounts because more water would be available for Lucky Peak power production during the development period, and Deer Flat pumping plant costs would be less. Annual costs for this period are assumed to be $445,152.

The aforementioned repayment plans B and C show that the project is financially feasible. Water charges shown are well below the recommended charge of $9.68 per acre for the north-side pumping division of the Minidoka project in Idaho. The lands under the alternate plan should have a higher repayment capacity than those in the north side pumping division because of lower elevation and longer growing season. (See H. Doc. 721, 81st Cong., November 27, 1950, for details on north side pumping division.)

The water charge of $8.50 per acre is 50 percent of the estimated average repayment ability of $16.66 per acre. It is reported that current Bureau of Reclamation practice is to set water prices as high as 75 percent of repayment ability. Of course, detailed studies of "ability to pay" should be made before a final water charge is set.

Under reclamation law, operation and maintenance costs would be the minimum charge for water. Table VII shows water charges of $7 per acre and above, which would bring revenues well in excess of the operation amd maintenance costs of $840,747 annually.

It is of interest to note that the project repayment can meet the repayment period limitation of 50 years specified in Bureau of the Budget Circular No. A–47, dated December 31, 1952.

The possible repayment plans show that no subsidy from "outside sources" would be required for the alternate plan. This compares to the $177,250,000 in the Payette unit plan (p. 293, H. Doc. 473, 81st Cong.) for the 183,000-acre project. The repayment plans assume that construction charges allocable to irrigation shall be repaid without interest in accordance with the general provisions of reclamation law (act of June 17, 1902, and acts amendatory thereto). Repayment is better than comparable projects because no allocation was made for future power use in the repayment plan for the Army Engineer's Lucky Peak Dam.

In closing, it should be pointed out that the alternate plan involves an exchange of water rights. This requires shifting the points of diversion and proving that substitute supplies can be provided equally satisfactory as to quantity, quality, and time. In estimating a "construction period" it would be well to allow some time for these difficult negotiations prior to the beginning of construction.

It is my opinion that the foregoing report answers your request of March 23, 1953. Your letter of March 23, 1953, Mr. Sloan's report of March 17, 1953, and the reservoir-operation studies furnished to me are attached for ready reference.

Respectfully submitted.

JAMES K. CARR, *Civil Engineer,*
Consultant on Irrigation and Reclamation,
Committee on Interior and Insular Affairs,
United States House of Representatives.

APPENDIX

EXHIBIT A

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D. C., March 23, 1953.

MR. JAMES K. CARR,
Civil Engineer, Consultant on Irrigation and Reclamation,
Interior and Insular Affairs Committee
House Office Building, Washington, D. C.

DEAR MR. CARR: In accordance with our conversation yesterday, there is enclosed the modified report of W. G. Sloan, dated March 17, 1953, on an Alternate plan for development of the Mountain Home project. It would be appreciated if you would analyze this report and give me your opinion, as an engineer, concerning the project's feasibility, together with any recommendations that you may care to make.

The irrigation of the Mountain Home desert is of such great importance to the people of Idaho and to the Nation that I am anxious to thoroughly explore every plan for its accomplishment. This particular proposal, if it is found to be feasible, would also correct the very serious drainage problem in the Boise Valley. Earlier plans to irrigate the Mountain Home Desert have been so costly as not to have the support of the potential irrigators and have not been reported favorably to the Congress by the interested Federal agencies. It is for this reason that I am hopeful that some less expensive plan can be found to put these fertile lands under irrigation.

In submitting this modified plan to you for review it is my understanding that you can report on it without a great deal of additional work. The analysis previously submitted to me in response to my request of December 31 regarding Mr. Sloan's November report appeared to be so nearly complete as to lead me to that conclusion. Perhaps you will be able to report on this modified proposal without repeating all the computations you have previously made.

In supplying this information to me please feel free to call upon my staff for assistance in order that the staff of the Interior and Insular Affairs Committee is not unduly burdened.

It is my intention, on the basis of the preliminary analysis which you have given me, and which indicates that the plan merits further study, to submit this proposal to the Secretary of the Interior for investigation of features upon which further knowledge should be had before a final conclusion is reached as to feasibility. I shall inform the Secretary that your engineering report will be made available to him when you have had an opportunity to complete your review.

Please advise me if there is any objection to the above, or if there are any assignments by Chairman A. L. Miller of the Interior and Insular Affairs Committee which whould make it impossible for you to comply with my request.

Sincerely yours,

HAMER H. BUDGE,
Member of Congress.

EXHIBIT B

AN ALTERNATE PLAN FOR THE DEVELOPMENT OF MOUNTAIN HOME PROJECT, IDAHO[1]

(By W. G. Sloan)

BOISE VALLEY DRAINAGE

The continued successful irrigation of some 315,000 acres of highly developed land in the Boise Valley is now and has for some time past become seriously threatened by a high sustained level of underground water.

The availability of Anderson Ranch Reservoir storage and imminent use of additional storage facilities at Lucky Peak Reservoir has firmed up the water supply for the irrigated areas so well that a profligate use of water in the valley has been encouraged. This added burden has overtaxed existing drainage facilities and resulted in a recurrence of water logging which has reached dangerous proportions. The organized irrigation and drainage districts in the valley are urgently seeking relief.

An economical solution requires that the water recovered by drainage facilities should be reused for irrigating additional land.

A plan is herewith proposed, as an alternate to that heretofore proposed by the United States Bureau of Reclamation, which offers a solution for that problem by the construction of 450 drainage wells, with an average depth of 60 feet and an estimated capacity of 2 second-feet per well. A total of 225,000 acre-feet of water per year can be developed by pumping these wells for a period of 125 days each year. A total underground-water development of 300,000 acre-feet can be obtained in an extremely dry year by extending the pumping season to 166 days. The extraction of this underground water should lower the water table between 4½ and 5 feet over 225,000 acres of land.

An average of 1,800,000 acre-feet of water is being diverted annually from the river for the valley lands. The actual consumptive use, which is the water actually required for diversified crops in the valley, has been estimated by the Bureau of Reclamation to be at the rate of 2.20 acre-feet per acre or a total of 693,000 acre-feet per year. The balance between supply and actual need is 1,107,000 acre-feet annually, which is either wasted back to the river or goes to fill up the underground-water reservoir beneath the valley lands.

In other words, the annual water supply has been sufficient to satisfy all crop needs, transpiration and evaporation losses, and fill the great underground reservoir which underlies the valley, and still allow return flow waste below all irrigation diversions in the amount of 540,000 acre-feet according to past records. It is because of the annual addition to the underground-water reservoir of more than a million acre-feet that this underground reservoir has been filled to its present extent.

Through the construction and pumping of drainage wells it is proposed to annually extract about 20 percent of the present contribution to ground water. A tentative location of the wells shows that by drilling them at intervals of approximately one-quarter of a mile, adjacent to each of the main supply canals below the Boise diversion dam, all of the water pumped from the wells can be delivered into the existing canals for reuse.

By substituting this developed water for that now used, an equivalent amount then becomes available for diversion higher up on the Boise River for irrigation of new lands. Should the development of ground water interfere with presently used return flows, additional wells will be supplied at the critical points to insure no impairment of existing rights.

It is not the intention to impair any existing water right in the valley to the slightest extent. The flexibility of the scheme of development here proposed will make it possible to insure that no such impairment should develop.

The estimated cost for development of this underground water and the resulting drainage relief is $3,015,000, or about $10 per acre of presently developed land.

The proposal to drain the valley lands by wells has been made before, and to date more than 100 wells have been constructed and are in operation—some of them for more than 25 years. Sufficient information has been obtained to assure the successful drainage of the land and the development of the proposed quantity of water. The principal drawback heretofore to universal drainage by pumping has been the cost of pumping power. The proposal hereing provides that the cost

[1] March 17, 1953.

of pumping the wells shall be borne by the new lands to be irrigated but the cost of installation of the wells shall be borne by the lands in the Boise Valley which are benefited by the drainage.

UNITED STATES BUREAU OF RECLAMATION ORIGINAL PLAN FOR IRRIGATING THE MOUNTAIN HOME PROJECT, IDAHO

In March of 1950 the Bureau of Reclamation issued a supplementary report containing a revised program for the development of the Mountain Home project, House Document No. 473. The plan provided for the irrigation of 183,000 acres of land and the installation of hydroelectric-generating capacity aggregating 180,000 kilowatts in 3 powerplants. The report states that no final plan has yet been devised for the irrigation of the remainder of the Mountain Home project, estimated to contain another 200,000 acres.

Briefly, that plan called for diversion of Payette River water to the Boise River by utilization of the Cascade Reservoir, a diversion dam near Smiths Ferry on the north fork of the Payette River near Garden Valley, and a series of tunnels and canals, which included 2 powerplants to develop 120,000 kilowatts. At Garden Valley a reservoir would be constructed on the south fork of the Payette, together with a powerplant of 60,000-kilowatt capacity and a diversion tunnel 30 miles long, called the More's Creek tunnel, to the Boise River adjacent to the Lucky Peak Dam. By this development a total of 990,000 acre-feet of water would be made available for use on the Mountain Home project. Of the total 183,000 net acres to be irrigated, 105,000 acres (Long Tom division) would be irrigated by diversion from the south fork of the Boise River below Anderson Ranch Dam through a 7-mile tunnel to the irrigated area in the vicinity of Mountain Home. The remaining acreage (Hillcrest division) would be irrigated through a series of gravity canals and supplementary pumping plants diverting from the river at Lucky Peak Dam.

The total estimated construction cost of this plan was $253,234,000, based on prices prevailing in April 1949. Of this total cost, $199,705,000 was allocated to irrigation and the balance to power, flood control, and fish and wildlife benefits. Thus, an investment of $1,090 per acre would be required to irrigate the unit. It was estimated that the water users on the project could repay $22,445,000 of this cost over a 50-year period, and that the balance of $177,250,000 would have to be returned to the project from other sources. Of the net returns from power revenues of the project, $99,855,000 would be applied on the irrigation cost, leaving another balance of $77,395,000 to be returned. No other means for repaying this remaining balance of $77,395,000 has been suggested except the proposal that it be paid out of some kind of a basinwide account, which Congress has so far refused to approve.

The high cost of the United States Bureau of Reclamation Mountain Home project has precluded its approval to date by either the Bureau of the Budget or Congress. Consequently, search has been continuously made for other alternatives.

THE ALTERNATE PLAN

The alternate plan proposed herein provides for the development of 123,000 acres on the Mountain Home project. This total is made up of 111,000 acres on the Long Tom division (almost identical with the United States Bureau of Reclamation acreage for that division) and only 12,000 acres of the proposed Hillcrest division. This plan can be accomplished without the diversion of any water from the Payette River watershed, thus eliminating all of the most expensive features of the original plan.

The attached map shows the locations of these acreages proposed to be irrigated and the general geography of the area. There is also shown the new lands, the presently irrigated lands along the Boise River where drainage problems exist, other lands remaining for possible future irrigation, as well as the Deer Flat Reservoir and Snake River.

The reason for proposing diversion of Payette River water to the Mountain Home project, as in the original plan, was a shortage in water supply on the Boise River. It is believed that, by the elimination of the 60,000 acres of the original plan, sufficient water can be obtained from drainage pumping, supplemented as needed with Snake River water for the remaining 123,000 acres without recourse to diversion from the Payette River.

On page 237 of House Document No. 473, which is the Bureau's report on the project, is the following paragraph:

"The average annual runoff of the Boise River at the diversion dam, just upstream from the city of Boise, is 1,755,000 acre-feet. The average amount of water required for the irrigation of Boise Valley lands, including present and contemplated reservoir operation loss, is 1,425,000 acre-feet. Hence, there is an average of 330,000 acre-feet surplus flows annually in the Boise River Basin."

For a median year preliminary water-supply studies show that 225,000 acre-feet of this surplus can be regulated and used when the Lucky Peak Reservoir, to be completed in 1954, is added to and used with existing storage facilities on the river. Details of this study can be made available. In extreme dry years none of this surplus may be usable.

WATER REQUIREMENTS

The Long Tom division is well adapted for efficient use of water because of the compactness of the lands, and the relatively small mileage of canals and laterals required to serve the area, with resulting small canal and lateral losses. In my opinion, a water requirement of 4.85 acre-feet per acre is sufficient for this project. I have computed this as follows:

	Acre-feet per acre
Consumptive use	2.20
Canal and lateral losses and waste	1.90
Deep percolation from the land	.75
Total	4.85

This figure of 4.85 acre-feet per acre is identical with average diversions of Boise River natural stream flow over the last 10 years.

The figure of 1.90 acre-feet per acre for main canal and lateral losses and surface waste is 40 percent of the diversion requirement. Reports of water used on the Boise reclamation project show an average amount of about 25 percent for canal and lateral losses. Surface waste has not been determined, but the balance of 15 percent for surface waste is a larger amount than is usually considered allowable with efficient distribution of the supply.

The figure of 0.75 acre-foot for deep percolation losses is based upon experiments conducted by the Department of Agriculture on Idaho irrigation lands in 1913 and 1914, and is a much larger amount than has frequently been used by the Bureau of Reclamation in estimating the water requirements on many other projects.

There will be required, therefore, for the 123,000 acres of land now proposed to be irrigated a total of 596,550 acre-feet or, in round numbers, 600,000 acre-feet. This required water supply can be realized in a median year by using 225,000 acre-feet of the surplus in the Boise River, above referred to, by pumping 150,000 acre-feet into Deer Flat Reservoir from Snake River, thus replacing an equal amount diverted from the Boise River, and by pumping 225,000 acre-feet from the underground water supplies in the Boise Valley and exchanging water for a like amount of new or developed water.

For all the above reasons I believe we are justified in using 4.85 acre-feet per acre as the water requirements under this plan, rather than a requirement figure of 5.4 used in past United States Bureau of Reclamation studies.

The supplementary supply from the Snake River, by pumping into Deer Flat, would be accomplished by a plant located on the river near the Marsing Bridge and delivered through a penstock into Deer Flat Reservoir. There is ample flow in Snake River at this site at all times to furnish the amount required without interfering with any water rights below.

This plant would be designed as a combination pumping and generation plant whereby water would be pumped into the reservoir during offpeak generation periods and additional power generated by running water out of the reservoir back through the pump-generator plant to develop onpeak power. Preliminary studies have indicated that considerable saving can be made by this type of pumping plant over a straight pumping operation, and the advantages far outweigh the increased cost of the installation. Over the past 56-year period it has been found that the plant would need to operate in 29 years out of the last 56, with partial operation for a few years, and for the remaining years would not be needed at all.

The study of the use of the combination pumping-generating plant is of a preliminary nature, and time has not permitted refinement of the preliminary estimate.

The data on this type of an installation are based on development work by the Allis-Chalmers Manufacturing Co., as reported by Charles H. Spink in Power

Engineering, October 1951. Tests by this company on two single-speed, vertical Francis-type, reversible pump turbines, built by them show a turbine efficiency of 87 percent and a pump efficiency of 88 percent. Adjustable wicket gates are provided so that the water flow can be adjusted to the point of maximum efficiency for each use.

The tailwater elevation of the Snake River-Deer Flat pumped storage plant will be 2,180, and the headwater elevation will be 2,511, with minimum water in Deer Flat Reservoir, and 2,530 with the reservoir full. Thus, the static head will vary from 331 to 360 feet. The plant on the river would be connected to the reservoir with approximately 5,800 feet of tunnel. The power input for pumping purposes will be approximately 15,000 kilowatts, and the power output for generation will be approximately 12,000 kilowatts.

The cost estimate of the plant was based on an estimate prepared by the Bureau of Reclamation, about 1936, when they prepared an estimate on a pumping plant on the Snake River to pump to the proper elevation and conduct the water to the reservoir in a canal. After making adjustments for different size and change in construction-cost index, it was determined that a straight pumping plant would cost approximately $2,000,000. The additional cost to add the generating feature to this pumping plant was estimated to be $80 per kilowatt of generating capacity ($25 per kilowatt additional for pump on same shaft as turbine, $55 per kilowatt additional for penstock and tunnel over cost of a canal). Thus, the total cost of $3,000,000 was determined.

The pumping plant will discharge 150,000 acre-feet in approximately 4,000 hours, or about 5½ months, which would be its normal operation in median water years. In dry years more pumping would be required, and there would be less time available for generating power except as the capacity of the plant was increased.

Studies have not as yet been completed as to the most economical size of pumping plant to be installed. This problem is an economical study, weighing the higher investment cost against the lower rates for offpeak power. The preliminary study for power-generation determination was based on the need in this area for summer power for irrigation purposes. The study was based on being able to supply sufficient water to Deer Flat Reservoir so that in the months of July and August approximately 43,400 acre-feet of water would be available for release through the generating plant. The study indicated that it would require 70 days of pumping to supply the above amount of water, and would require 18,300,000 kilowatt-hours. The water would be used in 62 days and would generate 11,400,000 kilowatt-hours. The loss of energy is 6,900,000 kilowatt-hours, or 37.8 percent of the input. At this time of year the water released through the Snake River-Deer Flat plant would increase the Snake River flows, which are below the flow required for maximum operation of downstream power plants. Therefore, anything that can be done to increase the river flow will increase the generation at downstream plants. There would be considerable value in the use of the plant for generation on winter peaks. The studies on this winter peak generation have not been completed.

ELECTRICAL ENERGY FOR PUMPING

In a median year the energy required for pumping by the various features of the alternate plan are as follows:

	Kilowatt-hours
Drainage pumping: 225,000 acre-feet, lifted 65 feet, at 82 kilowatt-hours per acre-foot	18,400,000
Snake River to Deer Flat Reservoir: 150,000 acre-feet, lifted 337 feet, at 428 kilowatt-hours per acre-foot	64,000,000
To Hillcrest Canal: 60,000 acre-feet, lifted 118 feet, at 150 kilowatt-hours per acre-foot	9,000,000
Total energy requirements	91,400,000

In extreme dry years more pumping will be required to permit the necessary exchange of water for the new lands. This will mean a maximum pumping requirement of 300,000 acre-feet from Snake River into Deer Flat Reservoir, and an additional total of 300,000 acre-feet from the drainage wells. This can be accomplished by increasing the pumping time of the drainage pumps from 125 to 166 days, and the pumping time of the Snake River plant from about 4 to 8 months. This lengthened pumping period is still within the irrigation season for the drainage pumps and will produce water at a time when it can be used for irrigation. Since the Snake River pumping plant pumps into the Deer Flat Reservoir, it is immate-

rial whether that pumping period is lengthened. Accordingly, even in the driest year there will be the necessary amount of water available for exchange. The energy requirement then becomes as follows:

	Kilowatt-hours
Drainage pumping: 300,000 acre-feet, lifted 65 feet, at 82 kilowatt-hours per acre-foot	24,600,000
Snake River to Deer Flat Reservoir: 300,000 acre-feet, lifted 337 feet, at 428 kilowatt-hours per acre-foot	128,000,000
To Hillcrest Canal: 60,000 acre-feet, lifted 118 feet, at 150 kilowatt-hours per acre-foot	9,000,000
Total energy requirement for a dry year	161,600,000

POWER FACILITIES

Lucky Peak Dam, a flood-control dam on the Boise River just below Arrowrock Dam, is now under construction. Its completion is scheduled for 1954. It is being so designed and built that power-generating facilities can be added at the lower end of the outlet tunnel, which was designed for just such a contingency. The Corps of Engineers, who are building the dam, estimate that a 48,000-kilowatt installation can be made, which will produce in a median year about 235,000,000 kilowatt-hours at an average head of 220 feet. The total estimated cost is $6,000,000.

Moreover, the energy produced at Lucky Peak cannot be considered as firm power as its output will depend upon releases for irrigation use in the Boise Valley. That type of generation is therefore ideally adapted to the pumping requirements of the alternate plan for the Mountain Home project. It is proposed to include this development in the project plan.

When the Long Tom tunnel is constructed, to divert water from the south fork of the Boise River to the Mountain Home area, there will be a fall of approximately 185 feet that could be developed for power. This would generate approximately 81,000,000 kilowatt-hours during the irrigation season. A preliminary study indicates that the cost of these facilities would be $3,955,000, itemized as follows:

A gravity section concrete diversion dam, 55 feet high, 136-foot crest length	$416,000
Diversion canal 2 miles long	949,000
Steel penstock 1,600 feet long, 15-foot diameter	520,000
23,000-kilowatt power installation, at $90 per kilowatt	2,070,000
Total	$3,955,000

With the Lucky Peak and Canyon Creek power developments, a combined median year output of 316,000,000 kilowatt-hours would be produced. In an extreme dry year this power output would be reduced to 257,000,000 kilowatt-hours.

The energy requirements for the alternate plan are 91,400,000 kilowatt-hours for a median year and 161,000,000 kilowatt-hours for an extremely dry year. The most economical manner in which this power can be transmitted to the Snake River pumping plant and the numerous drainage well installations is over existing facilities of the Idaho Power Co. with certain additional facilities, which would also be needed. It has been ascertained that the Idaho Power Co. is willing to transmit this power from the two plants to the requisite locations and receive payment in energy from the same plants for this service, thus no cash payments for energy are required. It has also been ascertained that the power company is willing to purchase all energy over and above the project requirements at a rate of 4 mills per kilowatt-hour. When the energy for pumping is to be paid for in kind, the requirements for the project then become as follows:

In a median year:	*Kilowatt-hours*
For delivery to Snake River pumping plant	64, 000, 000
4-percent transmission losses form Canyon Creek plant	2, 560, 000
Energy payment for transmission costs	21, 000, 000
Total	87, 560, 000
For delivery to drainage wells	18, 400, 000
14-percent transmission and distribution losses	2, 520, 000
Payment for transmission and distribution costs	20, 853, 000
Total	41, 773, 000
For delivery to Hillcrest	9, 000, 000
4-percent transmission losses	360, 000
Payment for transmission costs	300, 000
Total	9, 660, 000
Overall total	138, 993, 000
Estimated energy available:	
At Canyon Creek	81, 000, 000
At Lucky Peak	235, 000, 000
Total (for median year)	316, 000, 000

The surplus thus made available for sale is 177 million kilowatt-hours. All of the output of Canyon Creek is used for irrigation purposes, and 24 percent of the output at Lucky Peak is irrigation power.

In a dry year:	*Kilowatt-hours*
Delivery from Canyon Creek plant to Snake River pumping plant	69, 000, 000
Deliveries from Lucky Peak as payment for losses from Canyon Creek	2, 760, 000
For transmission costs from Canyon Creek	23, 000, 000
Total	94, 760, 000
From Lucky Peak to Snake River pumping plant	59, 000, 000
Payment for losses	2, 360, 000
For transmission costs	19, 670, 000
Total from Canyon Creek and Lucky Peak	175, 790, 000
For delivery to drainage pumping plants	24, 600, 000
Payment for losses	3, 440, 000
For transmission and distribution costs	29, 520, 000
Total	57, 560, 000
For delivery to Hillcrest pumping plant	9, 000, 000
Payment for losses	360, 000
For transmission costs	300, 000
Total	9, 660, 000
Overall total supplied:	
From Canyon Creek	69, 000, 000
From Lucky Peak	174, 010, 000
Total	243, 010, 000

Thus again all the output of the Canyon Creek plant is required for irrigation purposes. At Lucky Peak it requires 72 percent of its capacity for irrigation purposes. Since this much power must be reserved at Lucky Peak for irrigation purposes in a dry year, it is believed justifiable to allocate 72 percent of this cost to irrigation.

ESTIMATED COST

A comparison of the estimated cost of the two plans is given in the following tabulation:

THE ORIGINAL PLAN		THE ALTERNATE PLAN	
Mountain Home allocation of cost of Cascade Reservoir	$5,912,000	Deer Flat pumping and generating system	$3,000,000
Smiths Ferry diversion dam and reservoir	1,334,000	Boise Valley drainage, 450 wells, at $6,700	3,015,000
Smiths Ferry-Scriver Creek tunnel	9,189,000	Canyon Creek powerplant	3,955,000
Scriver Creek powerplants	17,323,000	Lucky Peak powerplant	6,000,000
Scriver Creek Dam and Reservoir	2,954,000		
Scriver Creek-Garden Valley tunnel	3,828,000		
	40,540,000		
Garden Valley Dam and Reservoir	21,073,000		
Garden Valley powerplant	5,877,000		
Boise-Payette aqueduct (including More's Creek tunnel)	115,873,000		
Hillcrest division:		Hillcrest Division (12,000 acres)	1,500,000
Main canal system	11,477,000		
Swan Falls pumping plant	2,145,000		
Lateral system	4,350,000		
Drainage	2,175,000		
Long Tom division:		Long Tom division:	
Diversion dam on Boise River	1,943,000	Diversion dam on Boise River	2,234,000
Long Tom tunnel	17,479,000	Long Tom tunnel	20,101,000
Canyon Creek diversion dam	175,000	Canyon Creek diversion dam	201,000
Long Tom main canal system	3,186,000	Long Tom main canal system	4,124,000
Lateral system	5,250,000	Lateral system	6,613,000
Drainage	2,625,000	Drainage	3,306,000
Other miscellaneous items	19,066,000		
Total for entire project	253,234,000	Total for entire project	54,049,000

The costs enumerated above are identical for the United States Bureau of Reclamation original plan. For the Long Tom division of the alternate plan the costs are as given in the Bureau's report except for proportionate increases due to the proposed slight increase in acreage and a blanket 15 percent increase to allow for increases in construction costs.

COST OF OPERATION AND MAINTENANCE

The annual operation and maintenance and replacement costs for the irrigation facilities herein are based upon the data taken from table 15, page 248 of House Document 473 (vol. II) where these items appear in the original Bureau report. Other operation and maintenance and replacement costs have been newly estimated in the tabulation below:

Irrigation facilities	Operation and maintenance	Replacement	Total operation and maintenance and replacement
Boise River diversion	$3,000	$500	$3,500
Hillcrest	7,500	1,800	9,300
Long Tom tunnel	2,200	1,400	3,600
Long Tom canal	52,500	5,900	58,400
Long Tom distribution and drainage	131,000	14,610	145,610
Hillcrest distribution and drainage	18,000	2,000	20,000
Deer Flat pumping plant	18,000	8,000	26,000
Boise drainage	12,000	8,000	20,000
Hillcrest pumping	6,000	4,000	10,000
Canyon Creek pumping plant (1.11 percent of $3,955,000)			43,500
Lucky Peak powerplant (1.11 percent of $4,320,000)			47,952
5 percent of $1,680,000 [1]			84,000
Total annual cost			471,852

[1] $1,680,000 is the portion of powerplant cost allocated to commercial power and subject to interest; 5 percent includes 3 percent interest and 0.89 percent amortization.

REPAYMENTS

The Bureau of Reclamation has estimated the repayment ability of farmers on this project from $5.25 to $10 per acre. Obviously an annual charge of $6 per acre can easily be met by the water users on the project, which is an annual repayment of $738,000 per year.

It has heretofore been shown that annually there would be 177,000,000 kilowatt-hours of power salable at 4 mills per kilowatt-hour, or a cash return of $708,000 per year.

The $3,000,000 construction cost of drainage facilities will be repaid by the Boise Valley irrigation districts at the rate of $75,000 per year, or an annual average of about 25 cents per acre.

The financial program for the project would then be as follows:

Annual income from new lands	$738,000
Annual income from drained lands in the Boise Valley	75,000
Power sales	708,000
Total income	1,521,000
Annual expenses	471,852
Annual balance to apply on repayment of construction costs	1,049,148

Applying this annual payment of $1,049,148 to the total estimated cost of $54,049,000, less $1,680,000 the portion of Lucky Peak powerplant assigned to commercial power and repayment is included in total annual expenses, would indicate that this project can repay its construction costs within a 50-year period. Thus the project appears to be one of the few projects which have been proposed in the last dozen years which offers promise of repaying in full its entire cost within a reasonable time.

CONCLUSION

In summary the alternate plan provides the following advantages:

1. An economical solution to the Boise River drainage problem.
2. Use of Boise River drainage water instead of transfer of Payette River water to Boise Valley.
3. Construction time would be reduced from 30 years to less than 10 years.
4. Entire cost would be repaid within about 50 years.
5. No duplication of facilities that would prevent additional development of the remaining suitable land when more water can be made available from other sources.

ADDENDUM

An Alternate Plan for the Development of the Mountain Home Project, Idaho

(By W. G. Sloan)

SUMMARY OF REPAYMENT

The construction cost of the irrigation facilities for the new land under this alternate plan is $334 per acre, and the landowners will repay approximately $75 of this cost. The investment in powerplants included in the project is $9,955,000, of which $8,275,000 will be repaid by the landowners through the power costs included in the $6 per acre annual charge. The power included in the annual charges ($2.09 per acre) will result in an average cost per kilowatt-hour of about 2.81 mills at the point of use. The profit from the sale of the surplus power not required by the project will pay the balance of the cost of the irrigation facilities, $259 per acre, and the remainder of the costs of the power plants ($1,680,000).

The construction cost of the drainage wells amount to about $10 per acre, contained in the Boise Valley irrigation districts affected, will be repaid by the irrigators in the Boise Valley.

The above repayment and costs of the alternate plan are compared with similar items in the original United States Bureau of Reclamation plan as follows:

Item	Bureau of Reclamation plan	Alternate plan
Annual water charge, per acre	$5.25	$6.00
Cost of irrigation facilities, per acre	1,000.00	334.00
Repayment by landowners (on irrigation and power)	22,455,000.00	17,500,000.00
Drainage repayment by irrigators		3,015,000.00
Repayment from power revenues	99,855,000.00	33,534,000.00
Federal subsidy	77,395,000.00	
Estimated construction time, years	29	10

Considering the immediate benefits that can be obtained from this alternate plan, the reasonable costs, and the ability to pay out in a 50-year period, certainly recommend serious consideration of this plan by all interested in reclamation development in Idaho.

Exhibit C

RESERVOIR OPERATION STUDIES

Boise River Reservoir Stages, by Months (Critical Period)

ASSUMED DATA

Irrigation draft of 2,100,000 acre-feet of natural flow for 310,000 acres Boise Valley lands plus 123,000 acres of Mountain Home project lands.

Pumping capacity of 300,000 acre-feet from Snake River into Deer Flat Reservoir plus 300,000 acre-feet pumping capacity in Boise Valley drainage pumps.

Irrigation draft and drainage pump output distributed by months as follows:

	Acre-feet (in thousands)						
	April	May	June	July	August	September	October
Irrigation draft	160	360	420	450	430	240	40
Drainage pumping	23	51	60	65	62	34	5

Deer Flat pumping capacity: 27,000 acre-feet per month for 11 months.

Pumps operated full capacity: September, October and November in all years.

Pumps started: January IF runoff forecasts show reservoir will not fill.

Irrigation capacity of reservoir system, including Lucky Peak, 1,125,000 acre-feet.

Irrigation year 1927–28

	October	November	December	January	February	March
Reservoir stage, start of month		619	790	888	978	1,057
Natural inflow		144	98	90	79	273
Drainage pump inflow		0	0	0	0	0
Deer Flat pump inflow		27	0	0	0	0
Irrigation outflow		0	0	0	0	0
Reservoir stage, end of month	619	790	888	978	1,057	[1] 1,125

	April	May	June	July	August	September
Reservoir stage, start of month	1,125	1,125	1,125	1,071	804	487
Natural inflow	317	852	306	118	51	41
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	0	0	0	0	0	27
Irrigation outflow	160	360	420	450	430	240
Reservoir stage, end of month	[1] 1,125	[1] 1,125	1,071	804	487	349

[1] Wasted 40 in June.

Irrigation year 1928–29

	October	November	December	January	February	March
Reservoir stage, start of month	349	391	469	515	588	665
Natural inflow	50	51	46	46	50	102
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	391	469	515	588	665	794

	April	May	June	July	August	September
Reservoir stage, start of month	794	863	940	893	633	329
Natural inflow	179	359	286	98	37	32
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	27	27	27	27
Irrigation outflow	160	360	420	450	430	240
Reservoir stage, end of month	863	940	893	633	329	182

Irrigation year 1929–30

	October	November	December	January	February	March
Reservoir stage, start of month	182	213	277	347	419	510
Natural inflow	39	37	70	45	64	104
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	213	277	347	419	510	641

	April	May	June	July	August	September
Reservoir stage, start of month	641	805	818	742	463	165
Natural inflow	274	295	257	79	43	35
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	27	27	27	27
Irrigation outflow	160	360	420	450	430	240
Reservoir stage, end of month	805	818	742	463	165	21

Irrigation year 1930–31

	October	November	December	January	February	March
Reservoir stage, start of month	21	68	140	184	256	328
Natural inflow	55	45	44	45	45	91
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	68	140	184	256	328	446

	April	May	June	July	August	September
Reservoir stage, start of month	446	513	483	261	0	0
Natural inflow	177	252	111	35	23	24
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	27	27	27	27
Irrigation outflow	160	360	429	450	430	240
Reservoir stage, end of month	513	483	261	−62	−318	−155

Irrigation year 1931–32

	October	November	December	January	February	March
Reservoir stage, start of month	0	23	81	117	183	247
Natural inflow	31	31	36	39	37	136
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	23	81	117	183	247	410

	April	May	June	July	August	September
Reservoir stage, start of month	410	636	918	1043	839	550
Natural inflow	336	564	458	154	52	42
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	27	27	27	27
Irrigation outflow	160	360	429	450	430	240
Reservoir stage end of month	636	918	1043	839	550	413

Irrigation year 1932–33

	October	November	December	January	February	March
Reservoir stage, start of month	413	444	527	568	639	707
Natural inflow	39	56	41	44	41	64
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0		0	0	0
Reservoir stage, end of month	444	527	568	639	707	798

	April	May	June	July	August	September
Reservoir stage, start of month	798	924	987	1, 125	867	566
Natural inflow	239	342	538	100	40	36
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	160	360	429	450	430	240
Reservoir stage, end of month	924	987	[1] 1, 125	867	566	423

[1] Wasted 40 in June.

Irrigation year 1933–34

	October	November	December	January	February	March
Reservoir stage, start of month	423	456	531	587	694	801
Natural inflow	41	48	56	80	80	152
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	456	531	587	694	801	980

	April	May	June	July	August	September
Reservoir stage, start of month	980	1,120	1,067	820	499	181
Natural inflow	250	229	86	37	23	25
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	37	27	27	27	27	27
Irrigation outflow	160	360	420	450	430	240
Reservoir stage, end of month	1,120	1,067	820	499	181	27

Irrigation year 1934–35

	October	November	December	January	February	March
Reservoir stage, start of month	27	56	132	183	262	343
Natural inflow	37	49	51	52	54	83
Drainage pump inflow	5	0	0	0	0	0
Deer Flat pump inflow	27	27	0	27	27	27
Irrigation outflow	40	0	0	0	0	0
Reservoir stage, end of month	56	132	183	262	343	453

	April	May	June	July	August	September
Reservoir stage, start of month	453	642	789	819	558	256
Natural inflow	209	429	363	97	39	30
Drainage pump inflow	23	51	60	65	62	34
Deer Flat pump inflow	27	27	27	27	27	27
Irrigation outflow	160	360	420	450	430	240
Reservoir stage, end of month	642	789	819	558	256	107

ANDERSON RANCH RESERVOIR STAGES, BY MONTHS (CRITICAL PERIOD)

ASSUMED DATA

Maximum capacity of reservoir for irrigation: 400,000 acre-feet.

Irrigation draft of 540,000 acre-feet use on Mountain Home project, distributed by months as follows:

	Acre-feet (in thousands)						
	April	May	June	July	August	September	October
Irrigation Draft	40	92	108	116	111	62	11

Irrigation year 1927–28

	October	November	December	January	February	March
Reservoir stage, start of month	[1] 0					
Natural inflow	26	44	34	32	25	66
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	15	59	93	125	150	216
	April	**May**	**June**	**July**	**August**	**September**
Reservoir stage, start of month	216					
Natural inflow	101	319	114	39	20	16
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	277	[2] 400	[2] 400	323	232	186

[1] Assumed.
[2] Released to Arrowrock 104 in May, 6 in June.

Irrigation year 1928–29

	October	November	December	January	February	March
Reservoir stage, start of month	186					
Natural inflow	18	17	15	15	16	33
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	193	210	225	240	256	289
	April	**May**	**June**	**July**	**August**	**September**
Reservoir stage, start of month	289					
Natural inflow	63	130	107	32	14	13
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	312	350	349	265	168	119

Irrigation year 1929–30

	October	November	December	January	February	March
Reservoir stage, start of month	119					
Natural inflow	16	15	24	14	20	33
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	124	139	163	177	197	230
	April	**May**	**June**	**July**	**August**	**September**
Reservoir stage, start of month	230					
Natural inflow	102	122	107	31	19	15
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	292	322	321	236	144	97

Irrigation year 1930–31

	October	November	December	January	February	March
Reservoir stage, start of month	97					
Natural inflow	22	18	15	17	17	27
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	108	126	141	158	175	202
	April	May	June	July	August	September
Reservoir stage, start of month	202					0
Natural inflow	58	95	39	13	9	9
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	220	223	154	51	−51	−53

Irrigation year 1931–32

	October	November	December	January	February	March
Reservoir stage, start of month	0					
Natural inflow	12	13	14	15	14	33
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	1	14	28	43	57	90
	April	May	June	July	August	September
Reservoir stage, start of month	90					
Natural inflow	107	232	196	61	21	16
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	157	297	385	330	240	194

Irrigation year 1932–33

	October	November	December	January	February	March
Reservoir stage, start of month	194					
Natural inflow	19	20	16	18	16	22
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	202	222	238	256	272	294
	April	May	June	July	August	September
Reservoir stage, start of month	294					
Natural inflow	84	143	202	39	17	15
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	333	389	[1] 400	323	229	182

[1] Released to Arrowrock in June, 83.

Irrigation year 1933–34

	October	November	December	January	February	March
Reservoir stage, start of month	182					
Natural inflow	17	20	20	22	26	55
Irrigation draft	11	0	0	0	0	0
Reservoir stage, end of month	188	208	228	250	276	331
	April	May	June	July	August	September
Reservoir stage, start of month	331					
Natural inflow	89	74	31	13	8	9
Irrigation draft	40	92	108	116	111	62
Reservoir stage, end of month	380	362	285	182	79	26

PLATE 1

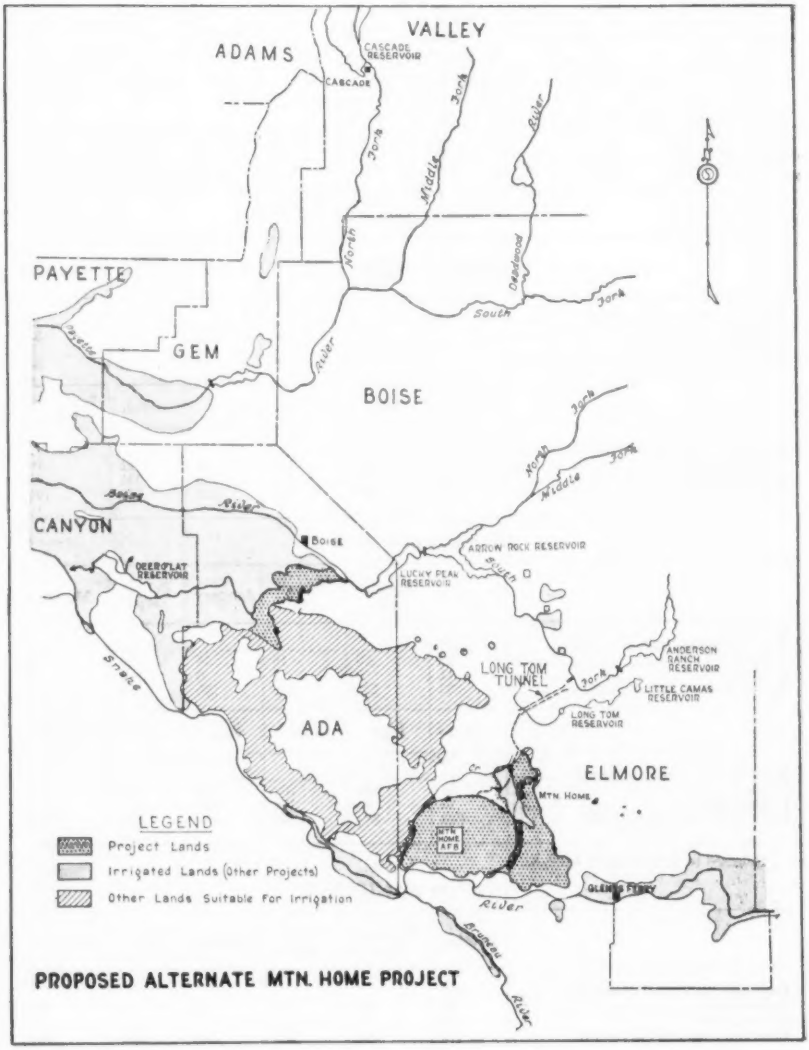
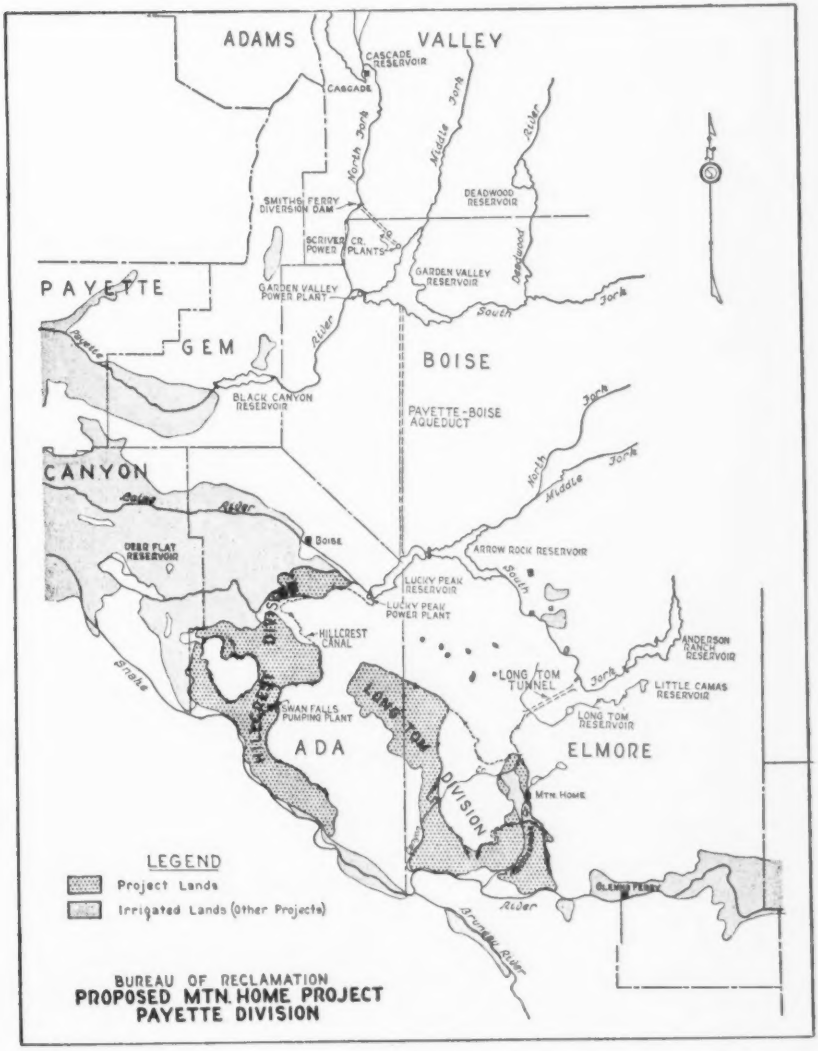

VALLEY
ADAMS
CASCADE RESERVOIR
CASCADE
PAYETTE
GEM
BOISE
CANYON
BOISE
DEER FLAT RESERVOIR
ARROW ROCK RESERVOIR
LUCKY PEAK RESERVOIR
LONG TOM TUNNEL
ANDERSON RANCH RESERVOIR
LITTLE CAMAS RESERVOIR
LONG TOM RESERVOIR
ADA
ELMORE
MTN. HOME
MTN. HOME AFB
GLENNS FERRY
North Fork
Middle Fork
South Fork
Payette River
Boise River
Snake River
Owyhee River
LEGEND
Project Lands
Irrigated Lands (Other Projects)
Other Lands Suitable For Irrigation
PROPOSED ALTERNATE MTN. HOME PROJECT

PLATE 2


ADAMS
VALLEY
CASCADE RESERVOIR
CASCADE
North Fork
Middle Fork
River
SMITHS FERRY DIVERSION DAM
DEADWOOD RESERVOIR
SCRIVER POWER
CO. PLANTS
GARDEN VALLEY POWER PLANT
GARDEN VALLEY RESERVOIR
Deadwood
South Fork
PAYETTE
GEM
Payette
River
BOISE
BLACK CANYON RESERVOIR
PAYETTE-BOISE AQUEDUCT
North Fork
Middle Fork
CANYON
Boise River
Boise
DEER FLAT RESERVOIR
ARROW ROCK RESERVOIR
LUCKY PEAK RESERVOIR
South
LUCKY PEAK POWER PLANT
HILLCREST CANAL
DEER FLAT
Snake
HILLCREST
LONG TOM
LONG TOM TUNNEL
ANDERSON RANCH RESERVOIR
LITTLE CAMAS RESERVOIR
LONG TOM RESERVOIR
SWAN FALLS PUMPING PLANT
ADA
ELMORE
DIVISION
MTN. HOME
LEGEND
Project Lands
Irrigated Lands (Other Projects)
Bruneau River
BUREAU OF RECLAMATION
PROPOSED MTN. HOME PROJECT
PAYETTE DIVISION